Measurement of Antimicrobial Drug Use

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Defined Daily Dose

- Target Audience: Administrators and Epidemiologists
  - Standardized definition of daily antibiotic dose
  - Created by the World Health Organization
  - Correction factor: $\frac{\text{Total Units (i.e. mg) Drug}}{\text{DDD Correction Factor}}$

- Pros:
  - Attempts to convert raw purchasing data into utilization data
  - Allows comparisons with other institutions
  - Easy to calculate

- Cons:
  - Not everyone agrees with the DDD correction factors
  - Many use institution-specific correction factors (prescribed daily dose)
  - Not patient level information

http://www.whocc.no/atc_ddd_index/

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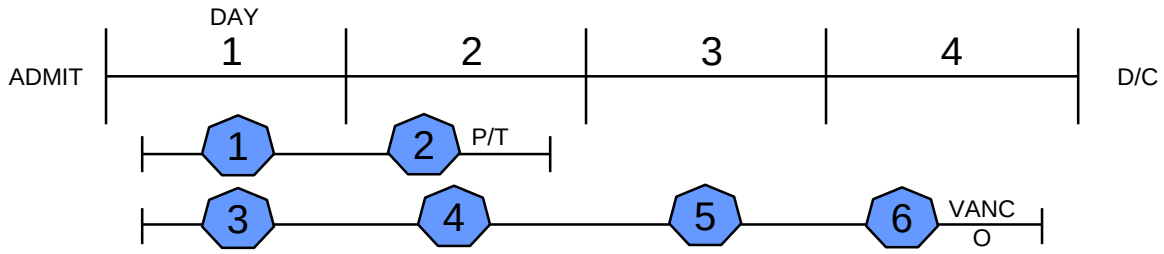
Days of Therapy (AKA Antimicrobial Days)

- Aggregate sum of days for which any amount of specific antimicrobial agent was administered to individual patients



- Obtained from electronic medication administration record (eMAR) or bar code medication administration (BCMA) data

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DDD vs. DOT
(Defined Daily Dose vs Days of Therapy)

DDD

- Pros:
  - Standard comparisons using aggregate utilization data
  - Will change estimate of drug use if high doses are use, but standard is not changed
- Cons:
  - Not a surrogate for DOT when dose is different than standard:
    - Cannot be used for: children, renal dysfunction
  - DDD can change with time

DOT

- Pros:
  - Can be used in children
  - Not influenced by changes in the DDD standards
  - Not subject to differences in institutional preference
  - Patient-specific information
- Cons:
  - Overestimates use for drugs given multiple times per day
  - More difficult to measure without computerized records

Polk RE. *Clin Infect Dis* 2007; 44:664-70.

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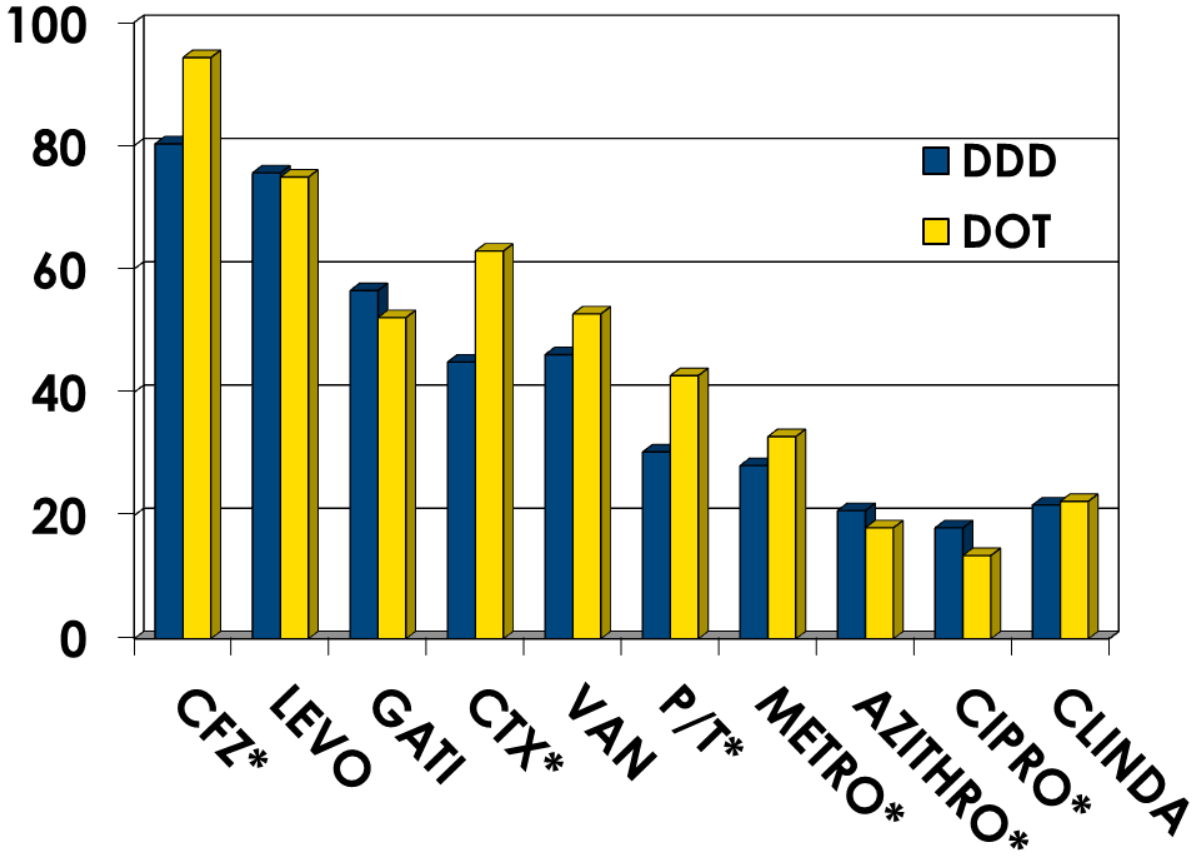
DDD vs. DOT



Polk RE. *Clin Infect Dis* 2007; 44:664-70.

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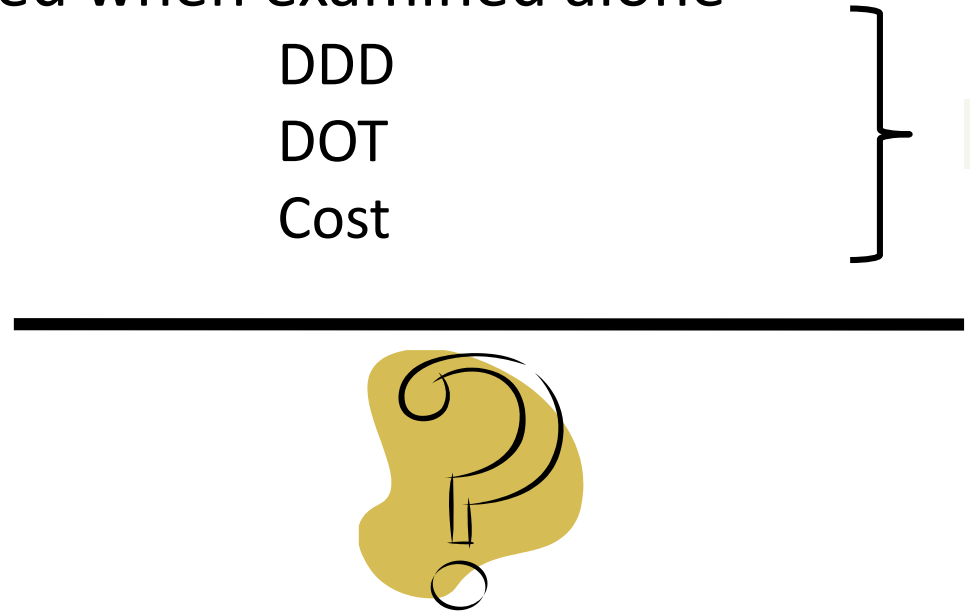
Getting to the bottom of the problem….

- Measures of antibiotic use are difficult to interpret and compared when examined alone

DDD
DOT
Cost

Numerator Values



A denominator is needed to standardize measurement of antibiotic use!

Available Denominators for Measuring Antibiotic Use

- Admissions:
  - CDC Definition: The aggregate number of patients admitted to the facility starting on the first day of each month through the end of the calendar month
- Patient Days:
  - CDC Definition: A daily count of the number of patients in the patient care location during a time period. To calculate patient days, for each day of the month, at the same time each day, record the number of patients.
- Days Present:
  - CDC Definition: number of patients present in a given location for any portion of any day

SO WE HAVE DATA - WHAT DO WE DO NEXT?

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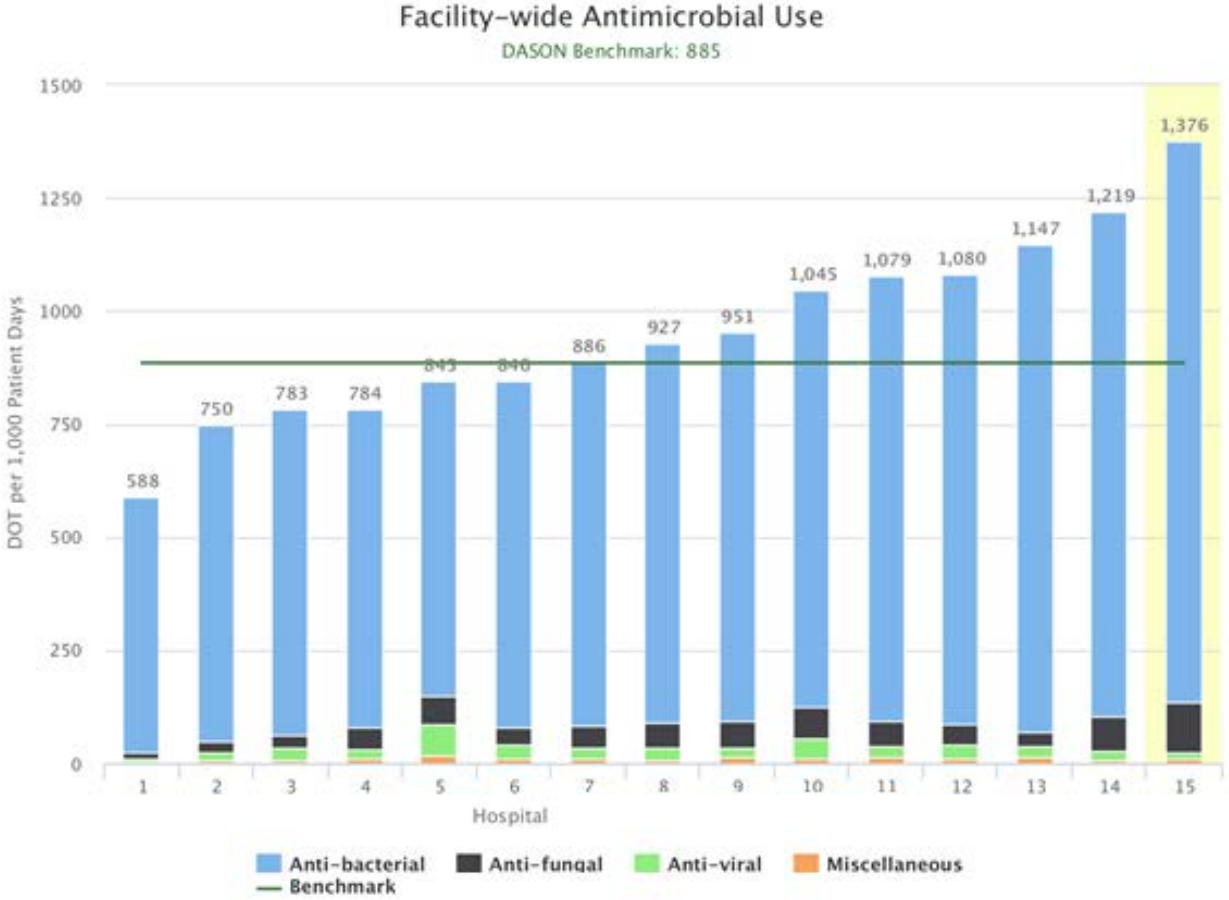
Find Out What Others are Doing: Example Benchmark Data



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What will we do with standardized data?
US Benchmarking Efforts

CDC- Antimicrobial Use and Resistance module

Objective: The primary objective of Antimicrobial Use option is to facilitate risk-adjusted inter- and intra-facility benchmarking of antimicrobial usage.

- Secondary objective: to evaluate trends of antimicrobial usage over time at the facility and national levels.

Primary metric: antimicrobial days/ 1000 days present

Data source: electronic MAR (with or without barcode medication administration)

But what about differences between facilities?

- National efforts underway to standardize antibiotic use in acute care hospitals
  - Similar to Standardized Infection Ratio (SIR) for US
    - Summary measure used to track HAIs
    - Summary statistic that compares a rate to baseline US experience adjusting for known risk factors
  - Proposed measure is Standardized Antibiotic Administration Ratio (SAAR)
    - Compares actual to expected antibiotic use after controlling for facility-level factors

Standardized Antibiotic Administration Ratio (SAAR)

$$\text{SAAR} = \frac{\text{Observed (O) Antimicrobial Use}}{\text{Predicted (P) Antimicrobial Use}}$$

- Predicted- Calculated by CDC based on predictive models based on nationally aggregated AU data
- Calculated for 5 different drug categories
- 4 different patient care locations
  - Adult/Pediatric medical, medical/surgical and surgical ICUs
  - Adult/Pediatric medical, medical/surgical and surgical wards

Antibiotic Groupings

- ***Broad spectrum agents for hospital-onset/multi-drug resistant infections***
  - Amikacin, aztreonam, cefepime, ceftazidime, ceftazidime/avibactam, ceftolozane/tazobactam, colistimethate, doripenem, gentamicin, imipenem/cilastatin, meropenem, piperacillin, piperacillin/tazobactam, polymixin B, ticarcillin/clavulanate, tigecycline, tobramycin
- ***Broad spectrum agents predominantly used for community-acquired infections***
  - Cefotaxime, ceftriaxone, ciprofloxacin, ertapenem, gemifloxacin, levofloxacin, moxifloxacin
- ***Anti-MRSA agents***
  - Ceftaroline, dalbavancin, daptomycin, linezolid, oritavancin, quinupristin/dalfopristin, tedizolid, telavancin, vancomycin
- ***Agents for surgical site infection prophylaxis***
  - Cefazolin, cefotetan, cefoxitin, cefuroxime, cephalexin
- ***All agents***

Locations Included

- **Broad spectrum agents for hospital-onset and community acquired, anti-MRSA agents**
- 1. adult medical, medical/surgical, and surgical ICU's
- 2. adult medical, medical/surgical and surgical wards
- 3. pediatric medical, medical/surgical and surgical ICU's
- 4. pediatric medical, medical/surgical and surgical wards
- **Surgical prophylaxis and ALL antibacterials**
- 1. adult ICUs and wards
- 2. pediatric ICUs and wards

Example Data

National Healthcare Safety Network

SAARs Table - All Standardized Antimicrobial Administration Ratios (SAARs) High-Level Indicators and High-Value Targets

As of: April 18, 2016 at 4:14 PM
Date Range: All AU_SAAR

All antimicrobials used in adult ICUs and wards

orgID	summaryYQ	SAARType	antimicrobialDays	numAUDaysPredicted	numDaysPresent	SAAR	SAAR_pval	SAAR95CI
13860	2014Q1	IND-Adult-1	4416	4421.364	6326	0.999	0.9437	0.970, 1.029
13860	2014Q2	IND-Adult-1	3998	3856.677	5668	1.037	0.0240	1.005, 1.069
13860	2014Q3	IND-Adult-1	3568	3952.912	5765	0.903	0.0000	0.873, 0.933
13860	2014Q4	IND-Adult-1	4287	3837.211	6189	1.117	0.0000	1.084, 1.151
13860	2015Q1	IND-Adult-1	4060	3113.877	5358	1.304	0.0000	1.264, 1.344
13860	2015Q2	IND-Adult-1	407	616.305	1132	0.660	0.0000	0.599, 0.727

Includes data for January 2014 and forward.
Data restricted to medical, medical/surgical and surgical locations.
Source of aggregate data: 2014 NHSN AU Data
Data contained in this report were last generated on March 15, 2016 at 10:33 AM.

Slide courtesy of Amy Webb, CDC

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Directing Interventions

National Healthcare Safety Network

SAARs Table - All Standardized Antimicrobial Administration Ratios (SAARs) High-Level Indicators and High-Value Targets

As of: April 18, 2016 at 4:14 PM
Date Range: All AU_SAAR

Antimicrobials used for hospital-onset/multi-drug resistant infections in adult ICUs

orgID	summaryYQ	SAARType	antimicrobialDays	numAUDaysPredicted	numDaysPresent	SAAR	SAAR_pval	SAAR95CI
13860	2014Q1	TAR-Adult-1	931	829.179	2800	1.123	0.0005	1.052, 1.197
13860	2014Q2	TAR-Adult-1	1066	661.243	2215	1.612	0.0000	1.518, 1.711
13860	2014Q3	TAR-Adult-1	926	697.669	2339	1.327	0.0000	1.244, 1.415
13860	2014Q4	TAR-Adult-1	613	429.632	1438	1.427	0.0000	1.317, 1.543
13860	2015Q1	TAR-Adult-1	265	209.499	700	1.265	0.0003	1.119, 1.424

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Making Better use of Your Time

National Healthcare Safety Network
SAARs Table - All Standardized Antimicrobial Administration Ratios (SAARs) High-Level Indicators and High-Value Targets
As of: April 18, 2016 at 4:14 PM
Date Range: All AU_SAAR

Antimicrobials used for hospital-onset/multi-drug resistant infections in adult wards

orgID	summaryYQ	SAARType	antimicrobialDays	numAUDaysPredicted	numDaysPresent	SAAR	SAAR_pval	SAAR95CI
13860	2014Q1	TAR-Adult-2	151	381.046	3526	0.396	0.0000	0.337, 0.463
13860	2014Q2	TAR-Adult-2	175	373.157	3453	0.469	0.0000	0.403, 0.542
13860	2014Q3	TAR-Adult-2	131	370.239	3426	0.354	0.0000	0.297, 0.418
13860	2014Q4	TAR-Adult-2	580	518.920	4751	1.118	0.0089	1.029, 1.212
13860	2015Q1	TAR-Adult-2	789	512.183	4658	1.540	0.0000	1.436, 1.651
13860	2015Q2	TAR-Adult-2	60	122.332	1132	0.490	0.0000	0.378, 0.627

Includes data for January 2014 and forward.
Data restricted to medical, medical/surgical and surgical locations.
Source of aggregate data: 2014 NHSN AU Data
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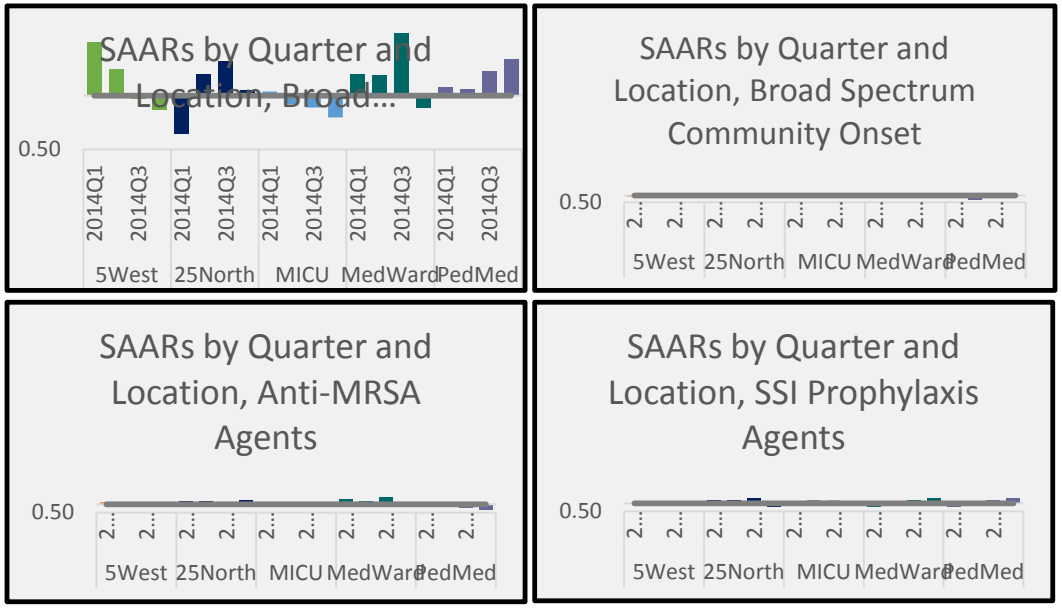
NHSN Output



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Is this required?

Hospital Inpatient Prospective Payment System
2017 Proposed Rule

- "In the future, we are considering proposing the NHSN Antimicrobial Use measure to advance national efforts to reduce the emergence of antibiotic resistance by enabling hospitals and CMS to assess national trends of antibiotic use to facilitate improved stewardship by comparing antibiotic use that hospitals report to antibiotic use that is predicted based on nationally aggregated data."

Slide Courtesy of Arjun Srinivasan, MD

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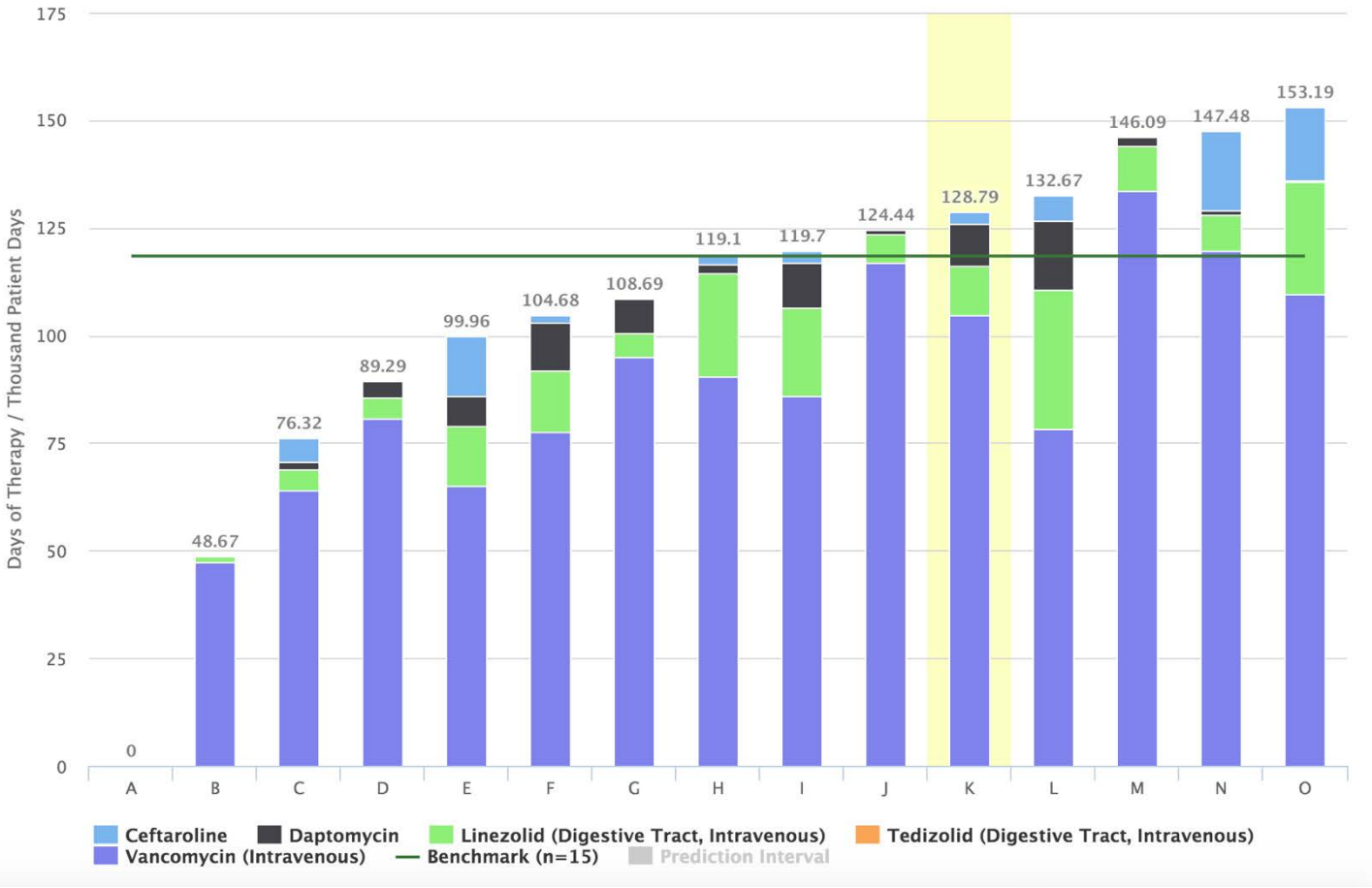
Drill Down: Anti-MRSA Therapy



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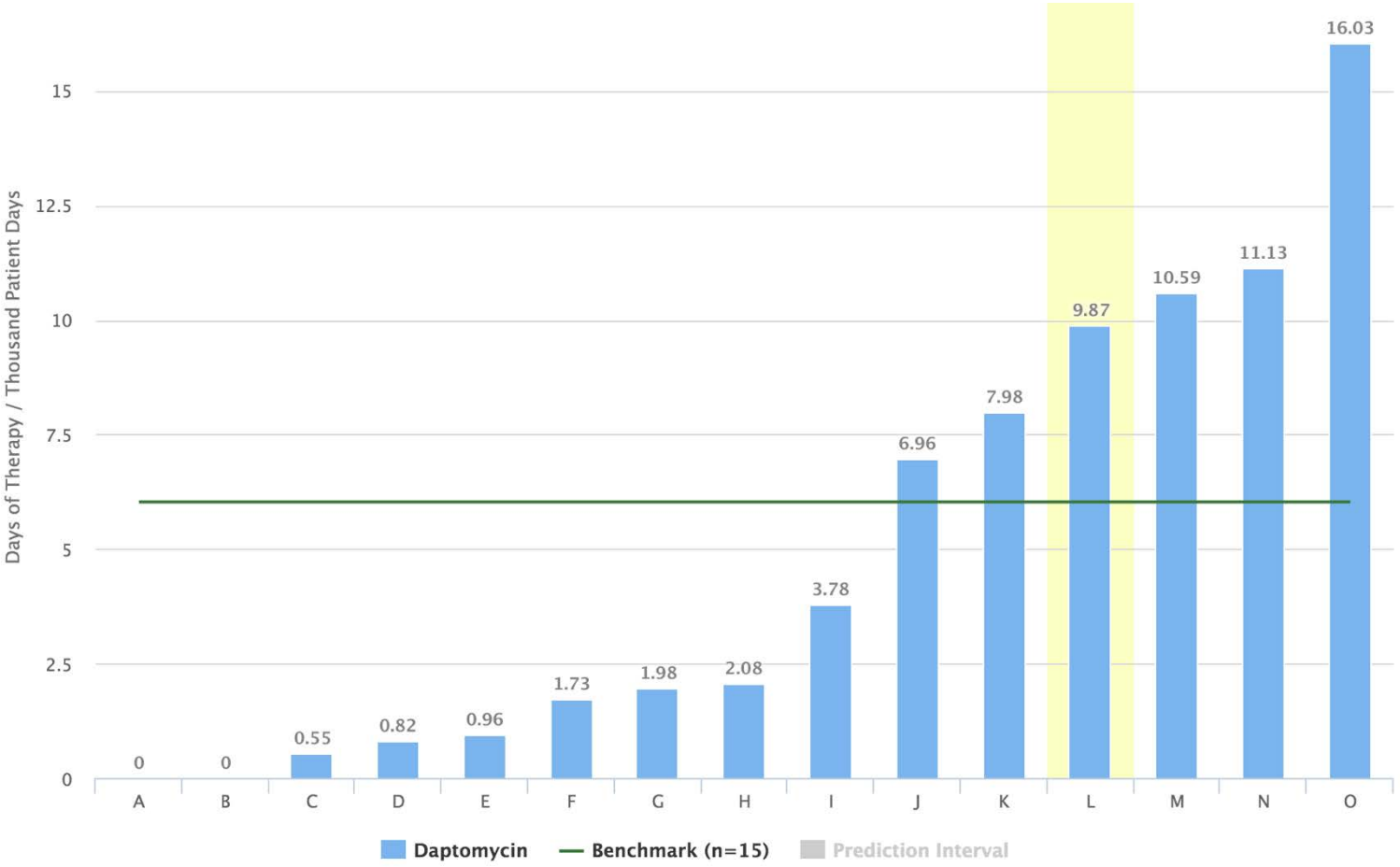
Drill Down: Daptomycin



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.. But there are lots of options

Length of therapy (LOT): number of calendar days in which the selected antimicrobial was received

When divided by the # of patients who received the agent this is a surrogate of duration per patient

Proportions:

% of patients receiving targeted agent

% of all patients receiving any antibiotic who receive the targeted agent

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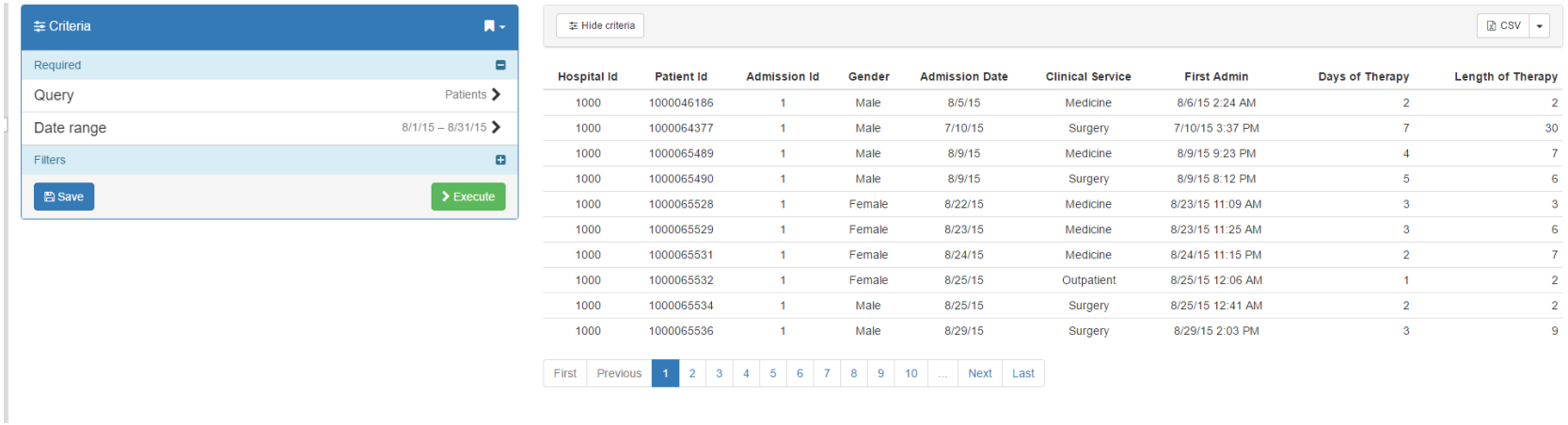
DOT vs LOT



Hospital Id	Patient Id	Admission Id	Gender	Admission Date	Clinical Service	First Admin	Days of Therapy	Length of Therapy
1000	1000046186	1	Male	8/5/15	Medicine	8/6/15 2:24 AM	2	2
1000	1000064377	1	Male	7/10/15	Surgery	7/10/15 3:37 PM	7	30
1000	1000065489	1	Male	8/9/15	Medicine	8/9/15 9:23 PM	4	7
1000	1000065490	1	Male	8/9/15	Surgery	8/9/15 8:12 PM	5	6
1000	1000065528	1	Female	8/22/15	Medicine	8/23/15 11:09 AM	3	3
1000	1000065529	1	Female	8/23/15	Medicine	8/23/15 11:25 AM	3	6
1000	1000065531	1	Female	8/24/15	Medicine	8/24/15 11:15 PM	2	7
1000	1000065532	1	Female	8/25/15	Outpatient	8/25/15 12:06 AM	1	2
1000	1000065534	1	Male	8/25/15	Surgery	8/25/15 12:41 AM	2	2
1000	1000065536	1	Male	8/29/15	Surgery	8/29/15 2:03 PM	3	9

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Examples of Using Alternate Metrics Data

	Numerator	Denominator	Rate
Daptomycin use in DOT/1000 patient days	714 DOT	72.35 1K Patient Days	9.87
% of patient admissions in which daptomycin was given			0.57%
% of antimicrobial admissions in which daptomycin was given			0.95%
LOT/Admission in which daptomycin was given	714 LOT	149 Admissions	4.79

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Using Alternate Metrics for Action

Hospital A			
	Numerator	Denominator	Rate
Vancomycin use in DOT/1000 patient days	7,565 DOT	72.35 1K Patient Days	104.56
% of patient admissions in which vancomycin was given			11.13%
% of antimicrobial admissions in which vancomycin was given			18.74%
LOT/Admission in which vancomycin was given	7,565 LOT	2,487 Admissions	3.04

Hospital B			
	Numerator	Denominator	Rate
Vancomycin use in DOT/1000 patient days	7,565 DOT	72.35 1K Patient Days	104.56
% of patient admissions in which vancomycin was given			7%
% of antimicrobial admissions in which vancomycin was given			11.1%
LOT/Admission in which vancomycin was given	7,565 LOT	1,244 Admissions	6.08

Making the Data Actionable

- Data alone will not answer all the questions, but is allows more refined reviews
  - Who?- Who is writing for the antibiotics?
  - What?- What is the most frequently used antibiotic?
  - Where?- Are there units that tend to use the most antibiotics?
  - When?- Are there times when antibiotics are most likely to be prescribed?
  - Why? - What is the most common reason antibiotics are used?
- From there
  - Conversations become more productive
  - Guidelines for use can be created with provider input
  - Remember- always ask why- the reasons behind the use might not be what you had guessed!

Conclusions

- There are many different ways to measure antibiotic use, each with distinct advantages and disadvantages.
- Important considerations when selecting a metric include:
  - Institutional vs. patient- level data
  - Desire to externally benchmark antibiotic use
  - Availability of data and ease of access

It is important to have some measure of antibiotic use:

"Don't just count your antibiotics, make your antibiotic counting count"